Project Management Mastery with Xcode

Making your project work for you

Session 408

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Apple Applications

Project Management Mastery with Xcode

Making your project work for you

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Xcode Architect

http://developer.apple.com/wwdc2005/

Introduction

- Simple projects are straightforward to set up
- Xcode provides great flexibility for complex projects

What Is a “Complex Project”?

- Many targets of different kinds
- Cross-project references
- Embedded frameworks and plug-ins
- Custom build configurations
- Shell script build phases and external targets
- Other special build requirements

What We'll Cover

- Project model concepts
- Targeting multiple versions of Mac OS X
- Creating universal binaries
- Keeping track of version numbers
- Fine-tuning your targets

What We Won’t Cover

- File editing
- File navigation
- Object modeling
- Project navigation
- Class browsing
- Debugging

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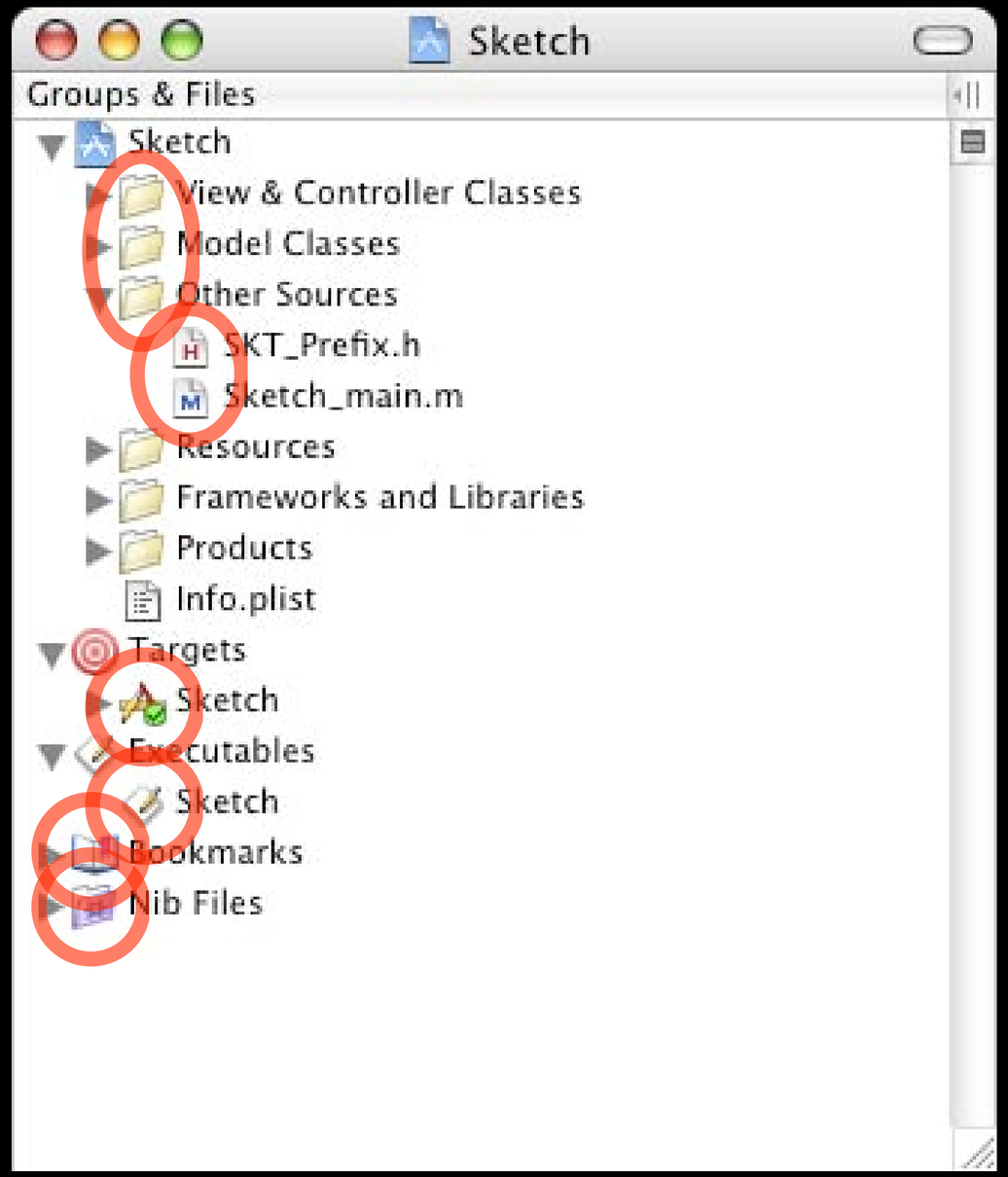
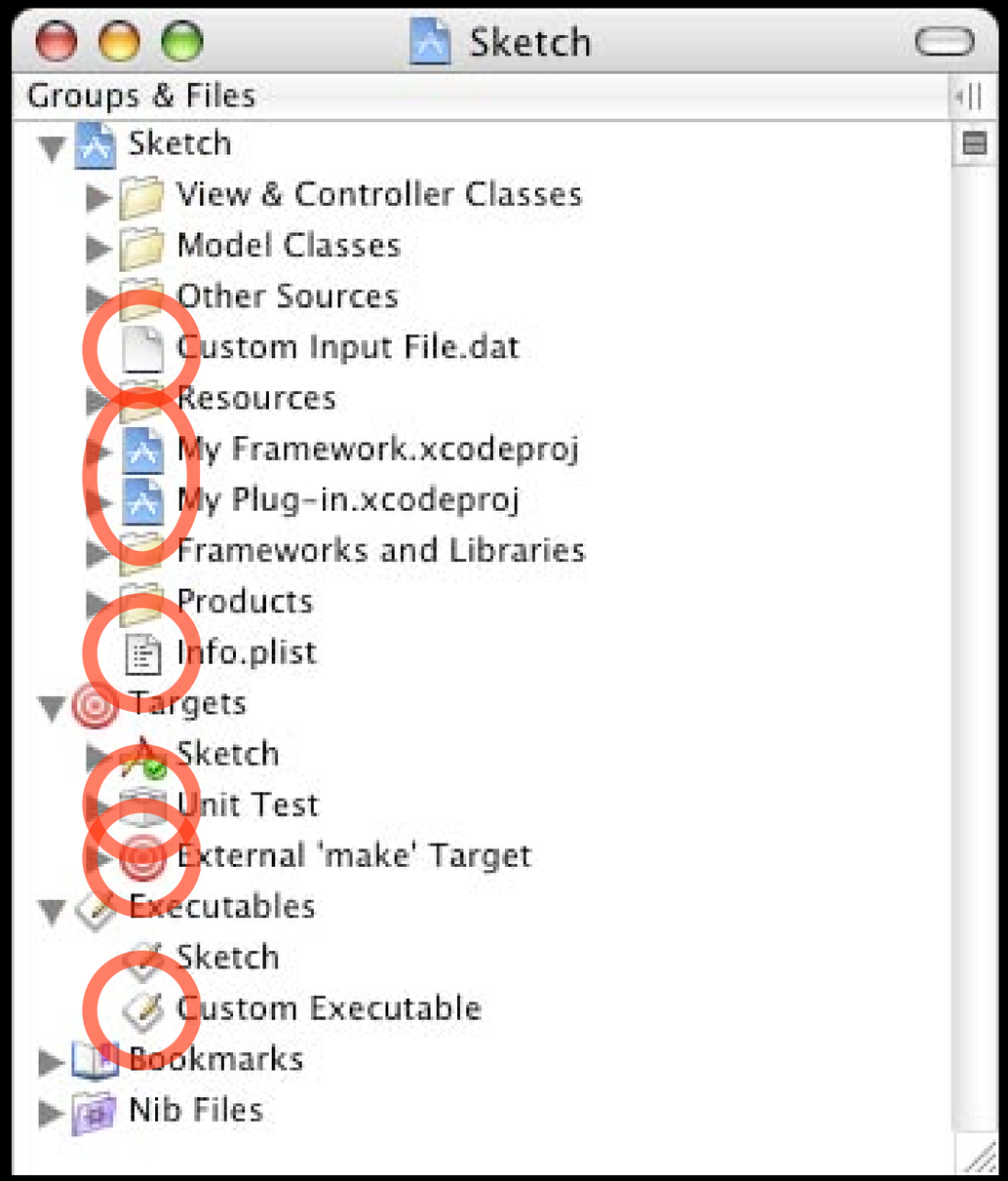


What's in a Project?

- Almost all projects have



What's in a Project?

- Complex projects might also have

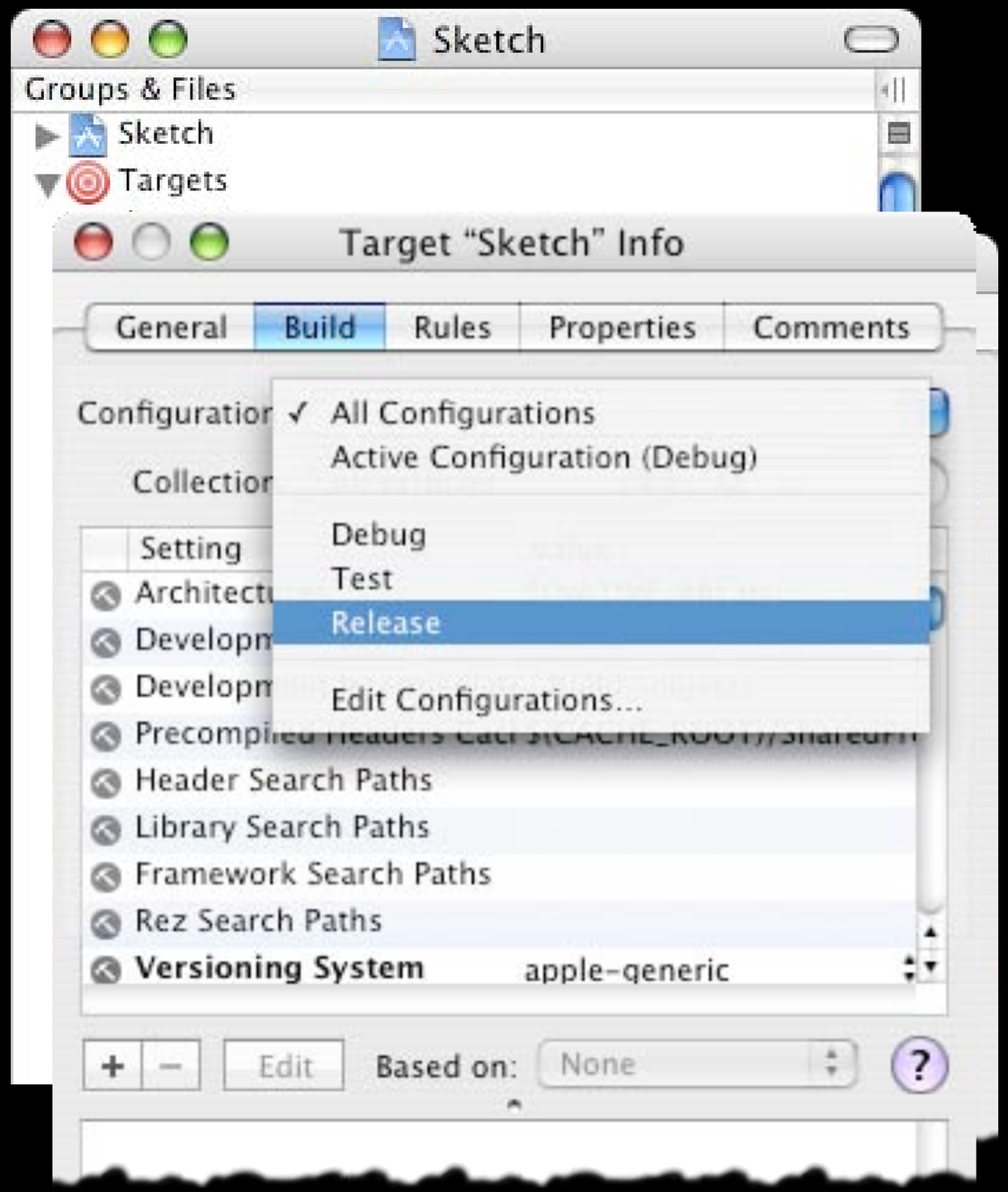
Project References

Advantages

- Divide large projects into small, manageable pieces
- Localize project configuration
- Targets can depend on targets in other projects
- Build all targets in all projects with a single action
- Reduce risk of SCM merge conflicts

Targets

- Main unit of organization for the build system
- Each target defines one logical product
  - e.g. application, framework, plug-in
- A target is like a recipe
  - Its “ingredients” are the files it refers to
  - Its “instructions” are its build phases and rules
- Targets can depend on other targets

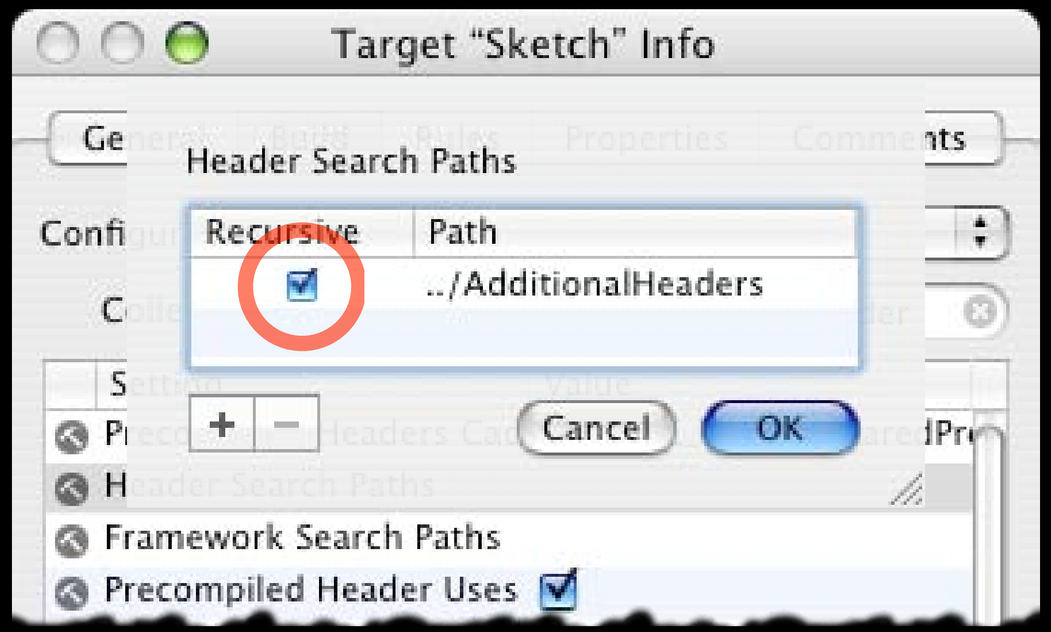


What's in a Target?

- Ingredients

Header Files

- Should I add my headers to the target?
  - Only add headers that need to be embedded in the product
  - No need to add headers just so that source code can find them
- All headers in the project are automatically accessible
- Xcode 2.0 supports recursive search paths



Build System

- Xcode has a fully integrated “native” build system
- Project and source code changes are reflected instantly
- Build system even starts compiling while you’re still typing

Build Phases

- Standard types
  - Copy Headers
  - Copy Resources
  - Compile Sources
  - Link
- Custom types
  - Copy Files
  - Run Script

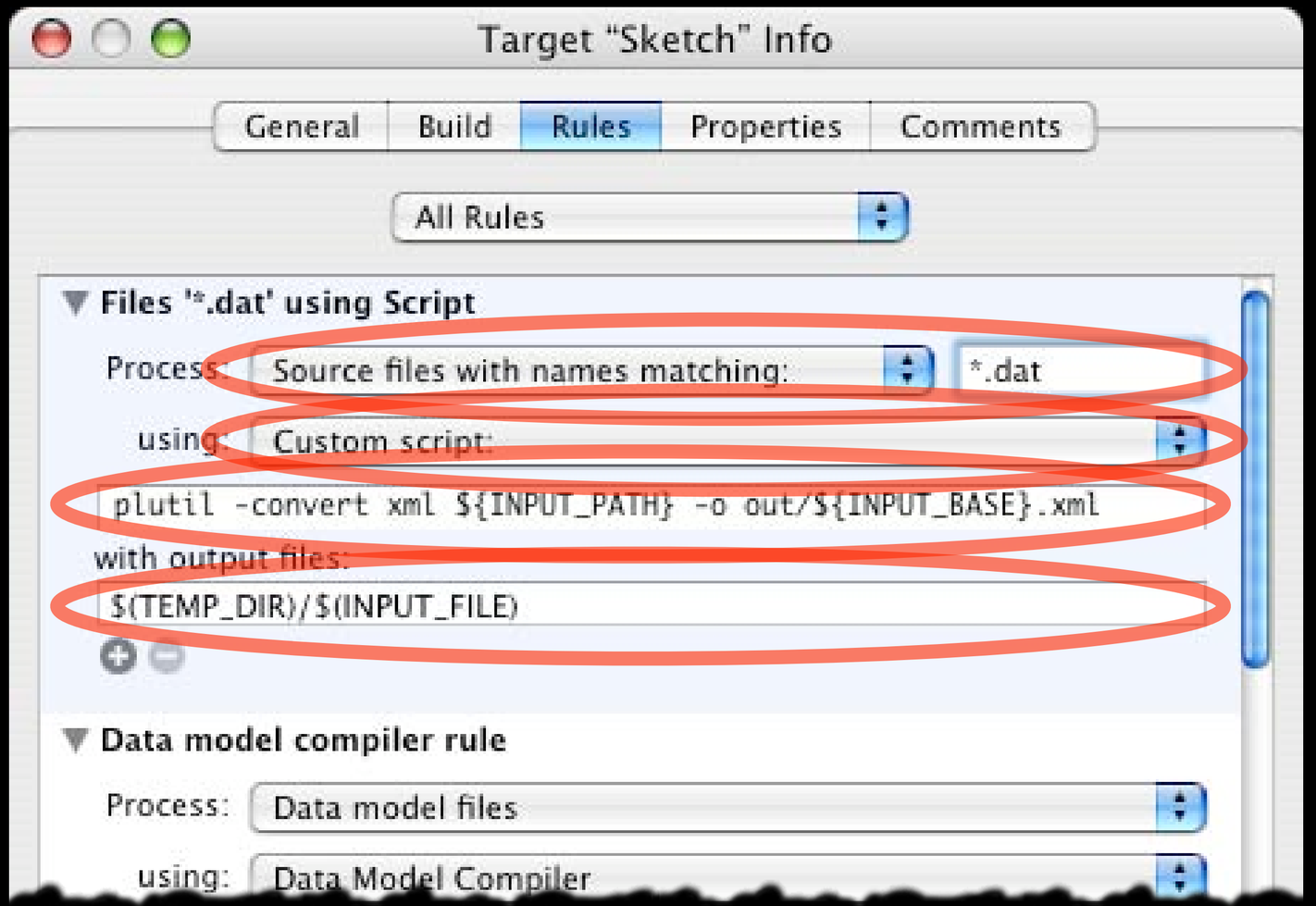
Build Rules

- Build rules specify how source files are processed
- Every rule has a condition and an action
- For each file, the first rule with a matching condition is used
- Use build rules to select compiler version
  - e.g. GCC 3.3 vs. GCC 4.0
- Also useful for generating source code from custom input files

Build Rule Condition and Action

- Condition selects files on which to operate
  - File type
    - e.g. “All Nib files”
  - File name pattern
    - e.g. `*.dat`, `Debug*.c`
- Action specifies what to do with those files
  - Invoke compiler
    - e.g. GCC 4.0 Compiler
  - Run custom script
    - e.g. `plutil -convert xml ${INPUT_PATH} -o out/${INPUT_BASE}.xml`

Build Rule Example



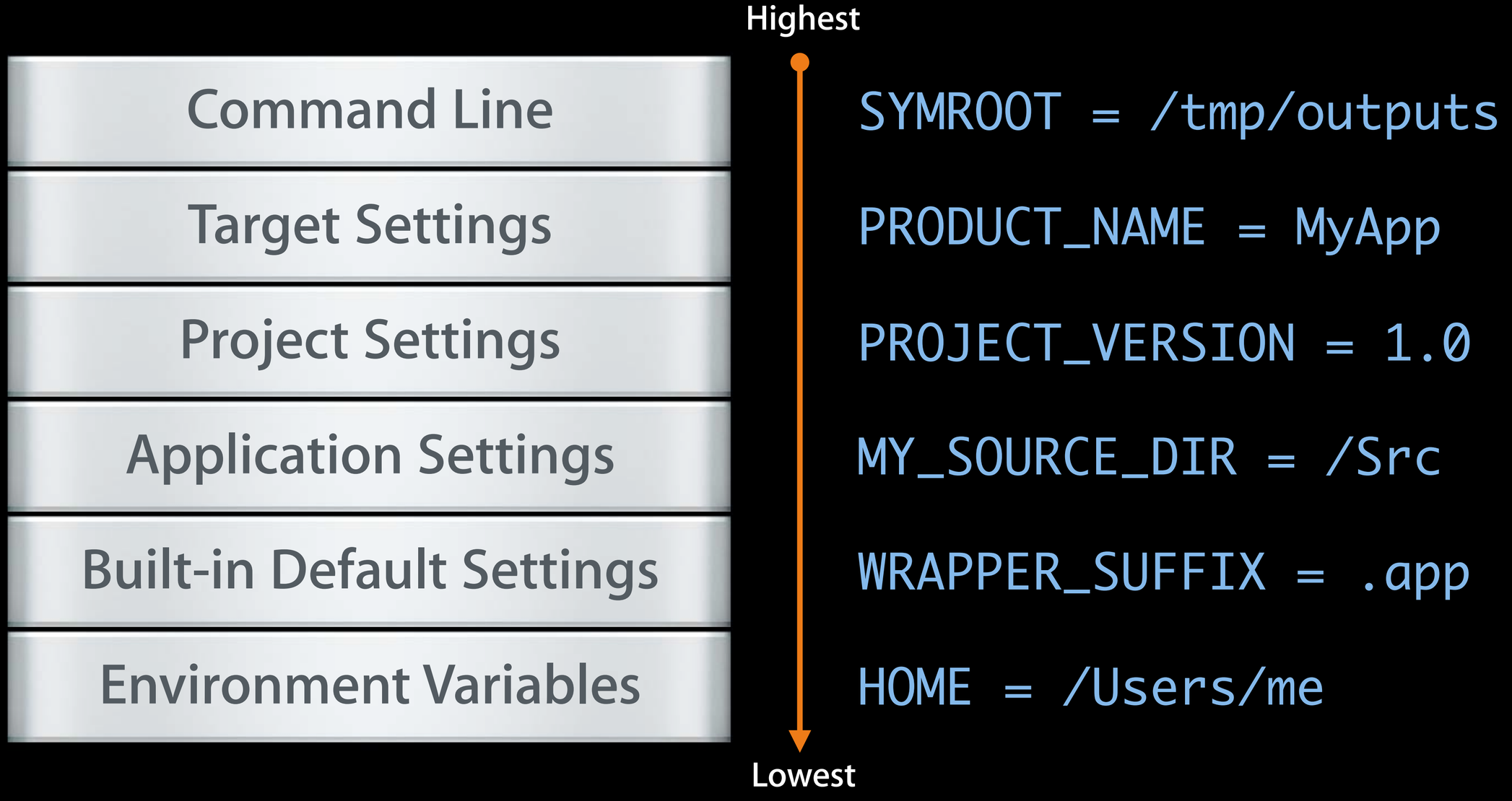
Useful Settings in Build Rules

- Input Files
  - `INPUT_FILE_PATH`—e.g. /src/MyProject/SourceFile.m
- Variants
  - `INPUT_FILE_DIR`—e.g. /src/MyProject
  - `INPUT_FILE_NAME`—e.g. SourceFile.m
  - `INPUT_FILE_BASE`—e.g. SourceFile
  - `INPUT_FILE_SUFFIX`—e.g. .m
- Build Locations
  - `TARGET_BUILD_DIR`—folder in which current target's product is produced
  - `BUILT_PRODUCTS_DIR`—folder containing symlinks to all built products

Build Settings

- Build settings are "knobs and switches"
- Most of the time, static values are appropriate
- A setting's value can also refer to other settings
  - e.g. `PRODUCT_NAME = MyApp_v$(VERSION_NUMBER)`
- Passed as environment variables to tools and scripts
- Can be set at either project or target level levels
- Precedence ordering of build settings
  - Higher levels override lower levels

Precedence of Build Settings



Build Setting Macro Expansion

- References to other build settings use `$(X)` notation
- Expansion occurs in the context in which the value is used
  - Same macro reference can expand differently in different contexts
  - e.g. `$(INPUT_FILE_PATH)` is different for every source file
- Special case: `$(value)` expands to the overridden value
- References to undefined settings are removed

Build Configurations

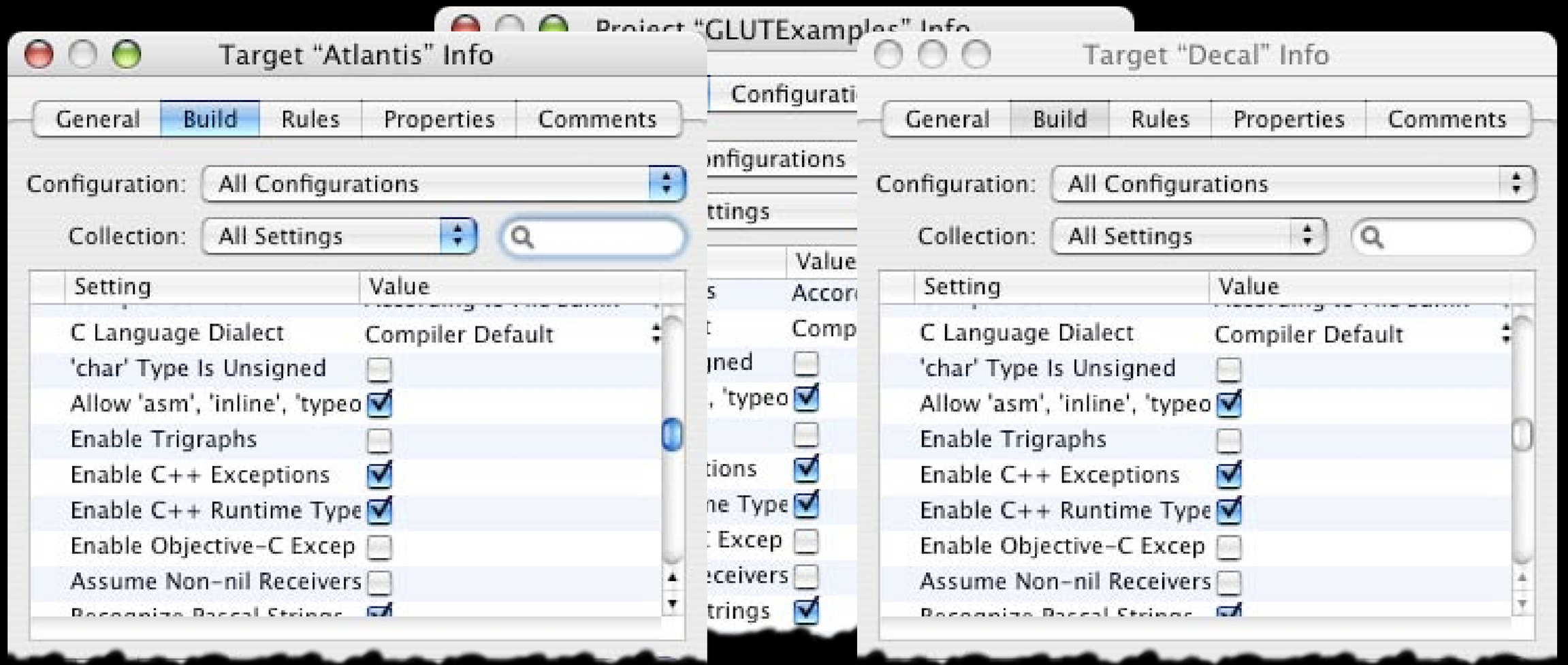
- Build settings are defined in named *configurations*
- Each build configuration has
  - Name (unique within a project)
  - Build settings
- New projects have configurations named “Debug” and “Release”
- Upgraded projects also have “Default” configuration
- Can have as many configurations as you like with any names you want

Build Configurations (Cont.)

- The project and each target has the same set of build setting names
  - Analogy: Method interface
- Each individual build configuration defines its own meaning
  - Analogy: Method implementation

Settings at the Project Level

- All targets in the project inherit build settings defined at the project level



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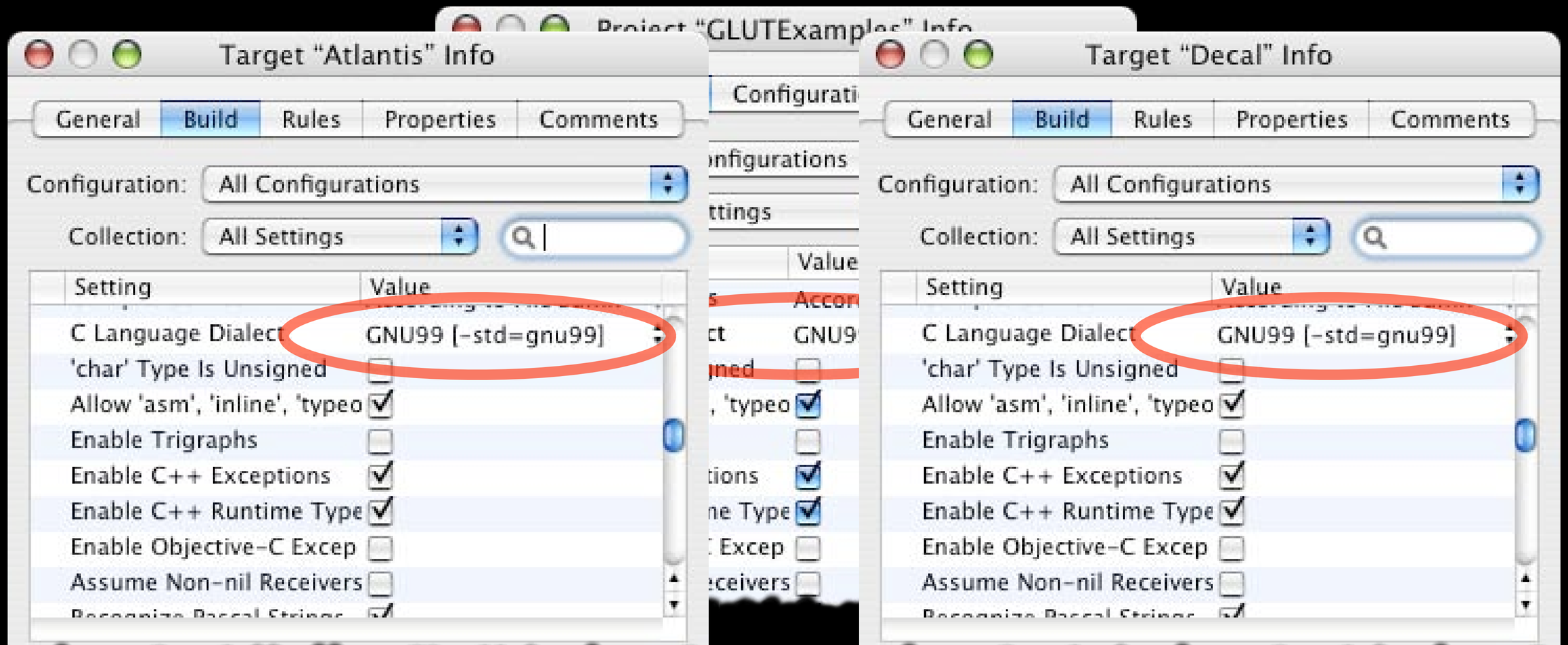
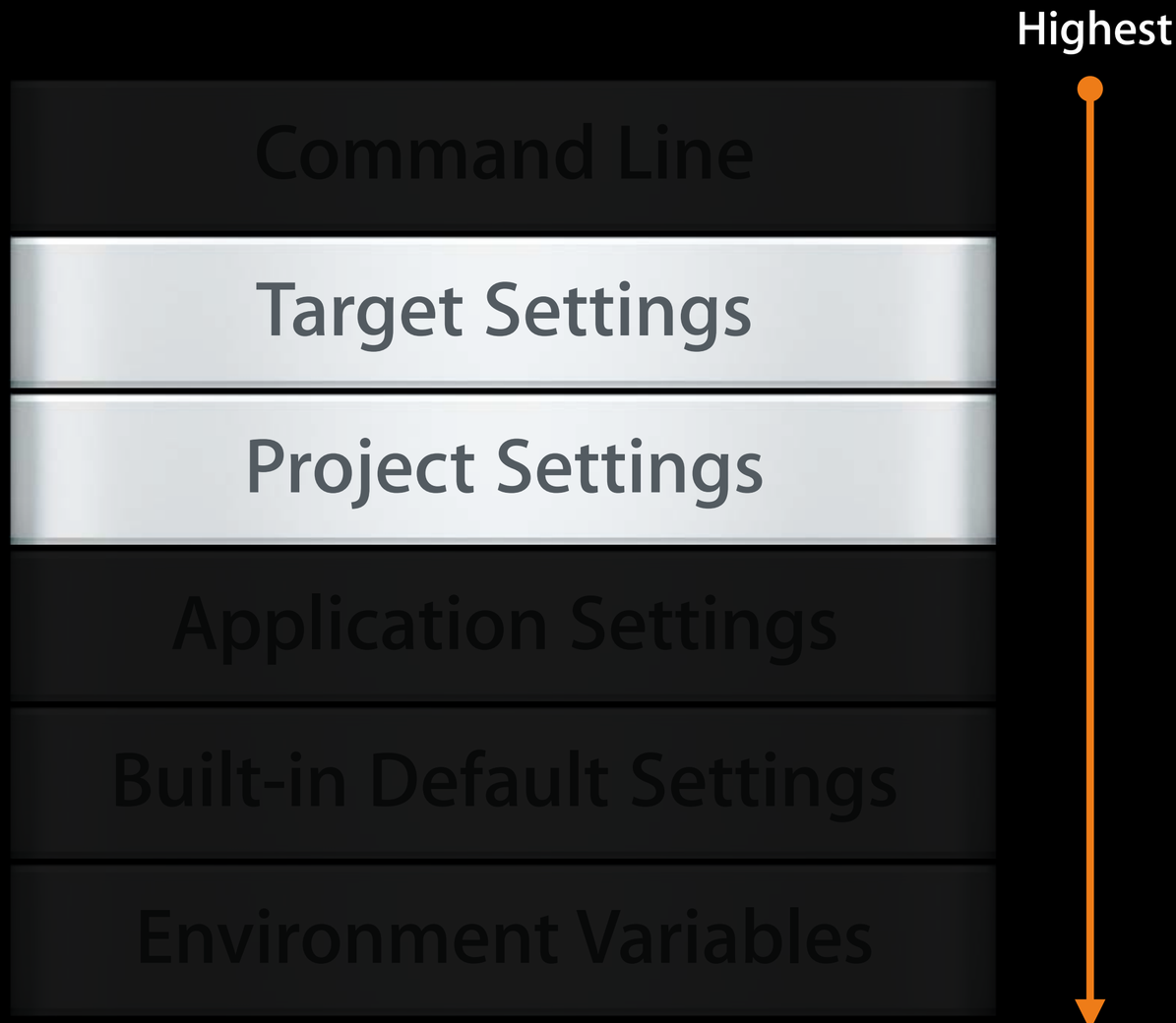


Basing Build Configurations on .xcconfig Files

- Include .xcconfig text files in your project
- Contains a list of `SETTING=VALUE` pairs
- Prototype with drag-and-drop from inspectors
- Multiple targets can share the same config file
- Reuse the .xcconfig files across projects

Build Setting Precedence Revisited



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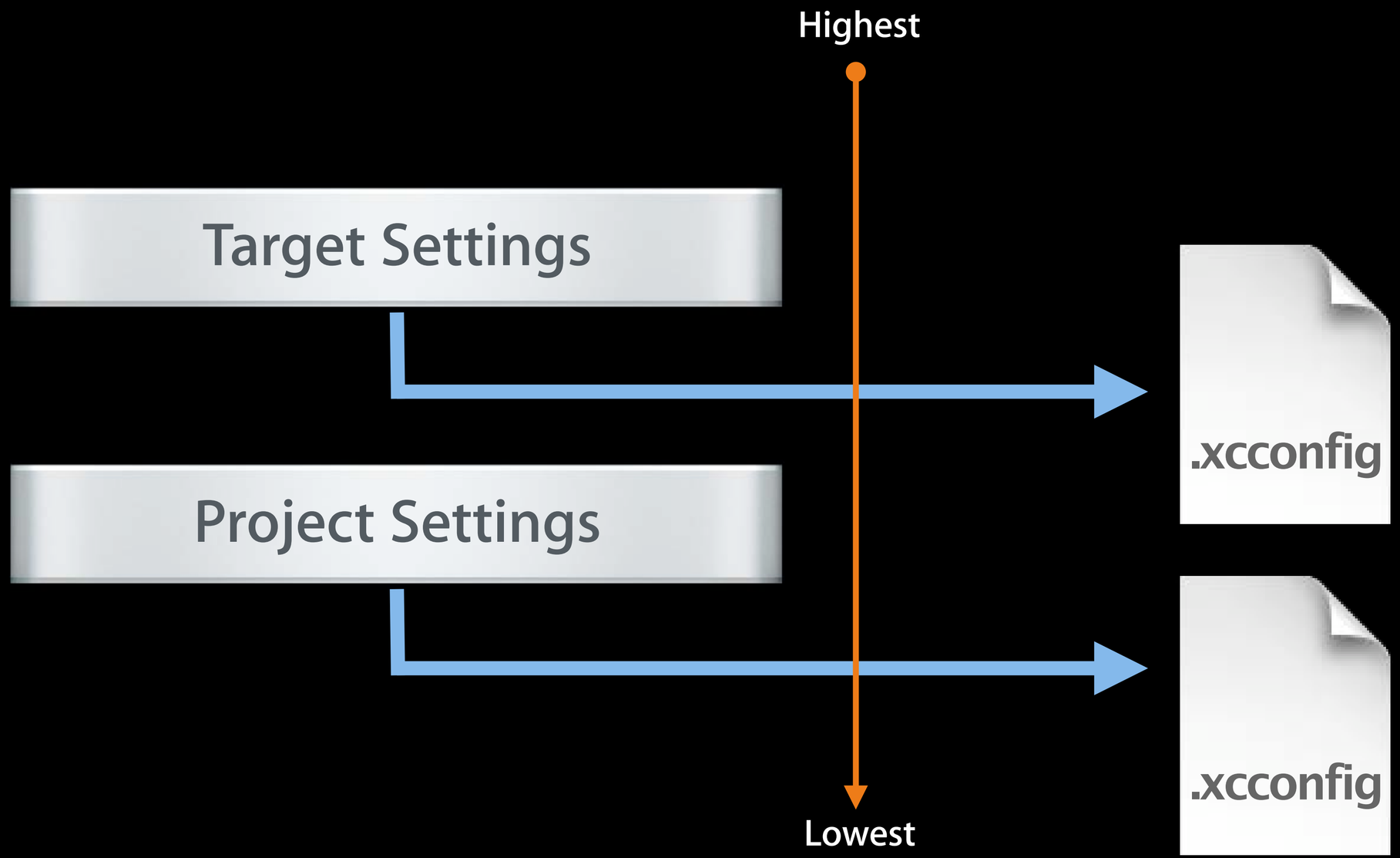
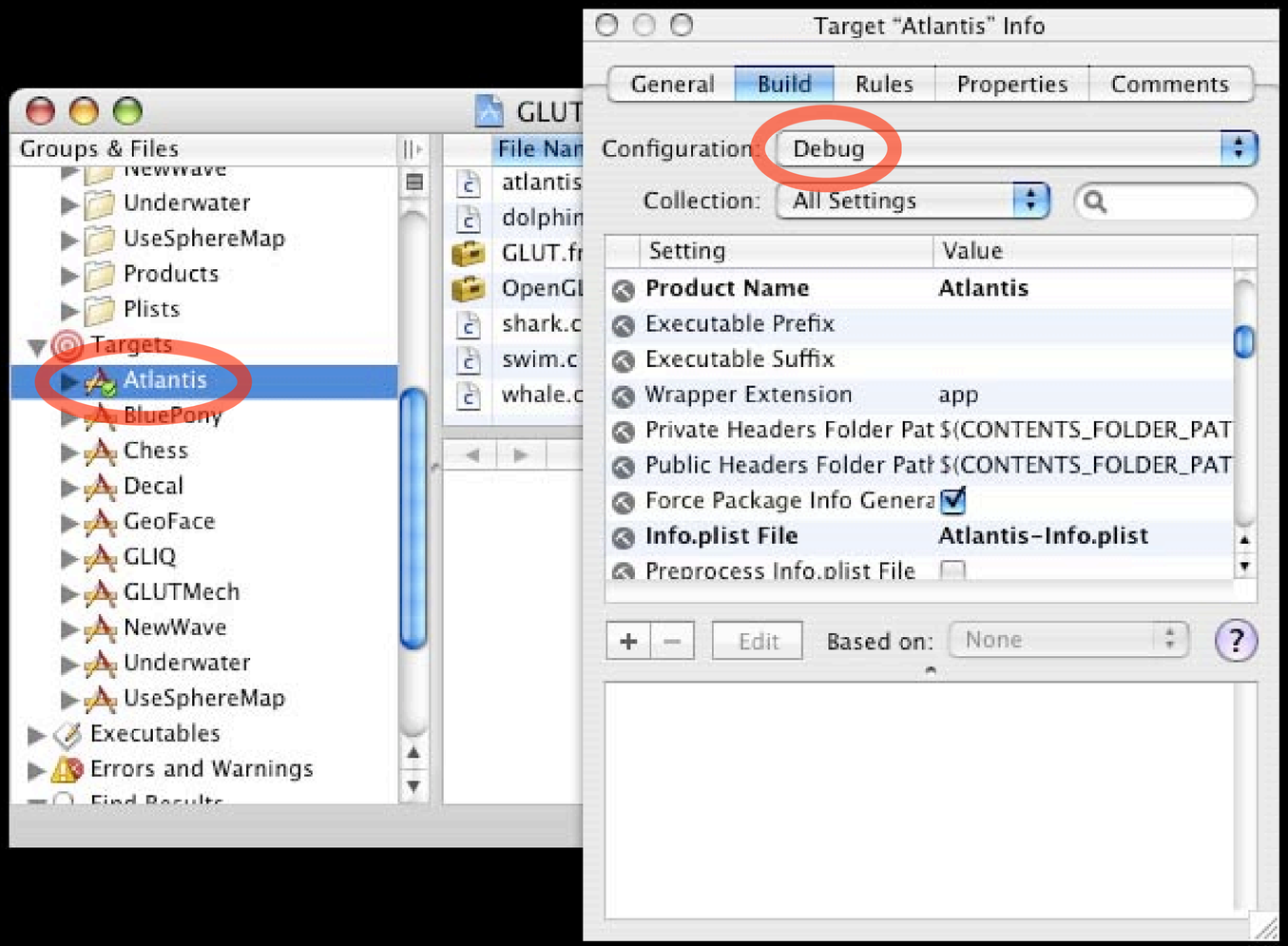


Effective Use of the Settings Inspector

Making sure the settings end up where you want them



	Debug	Test	Release
Atlantis			
BluePony			
Chess			
Decal			
GeoFace			
GLIQ			
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NewWave			
Underwater			
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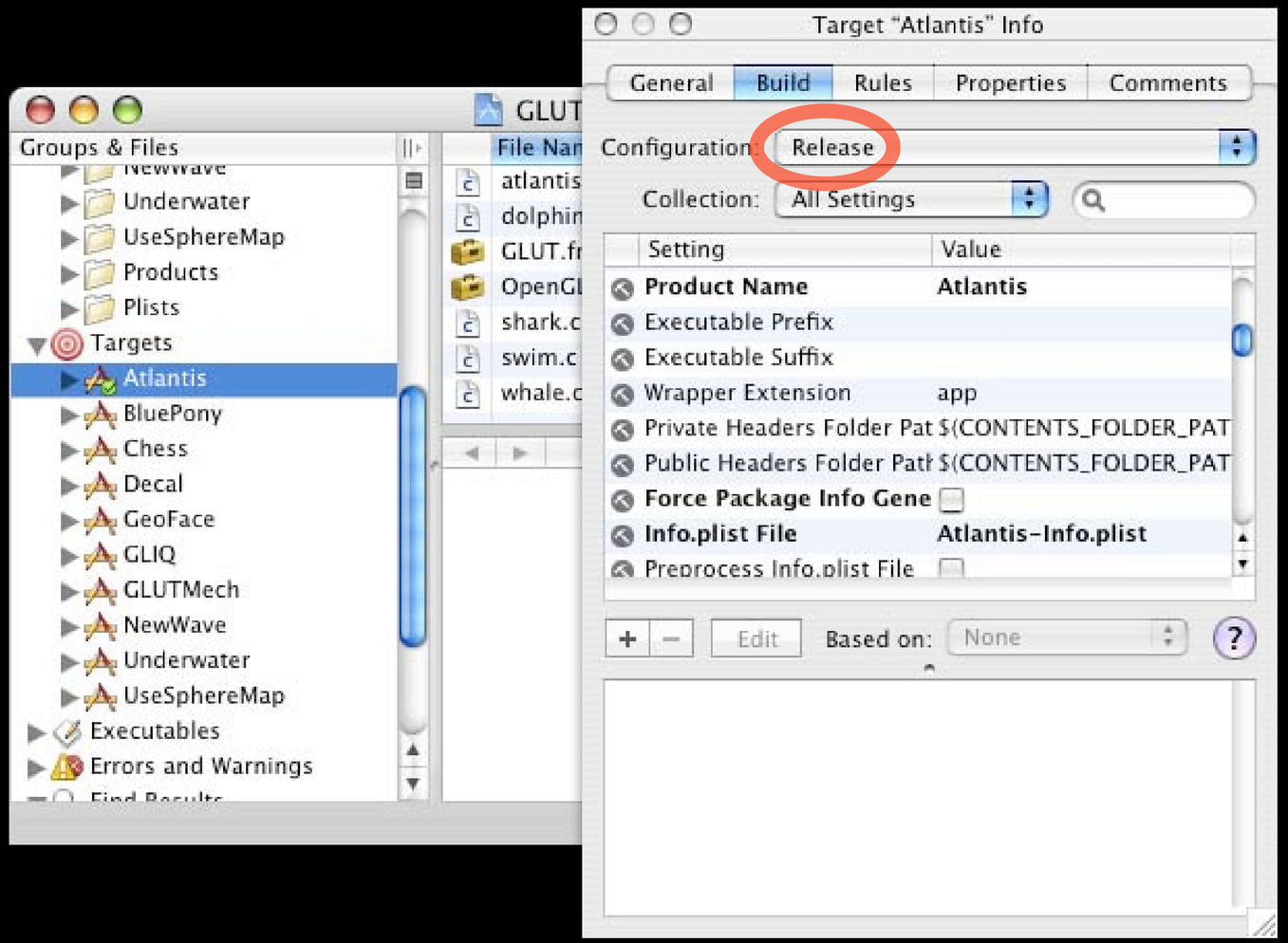

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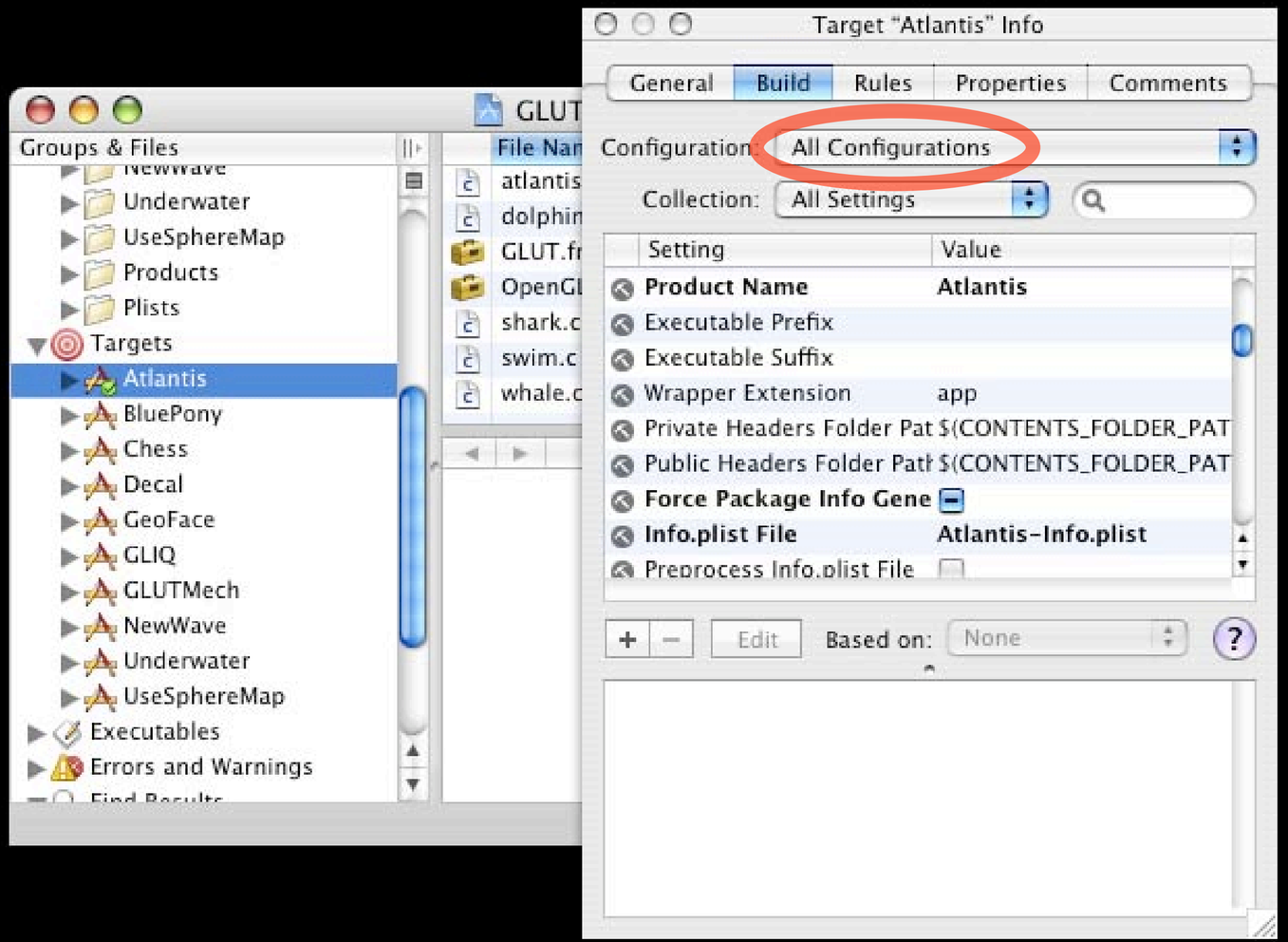

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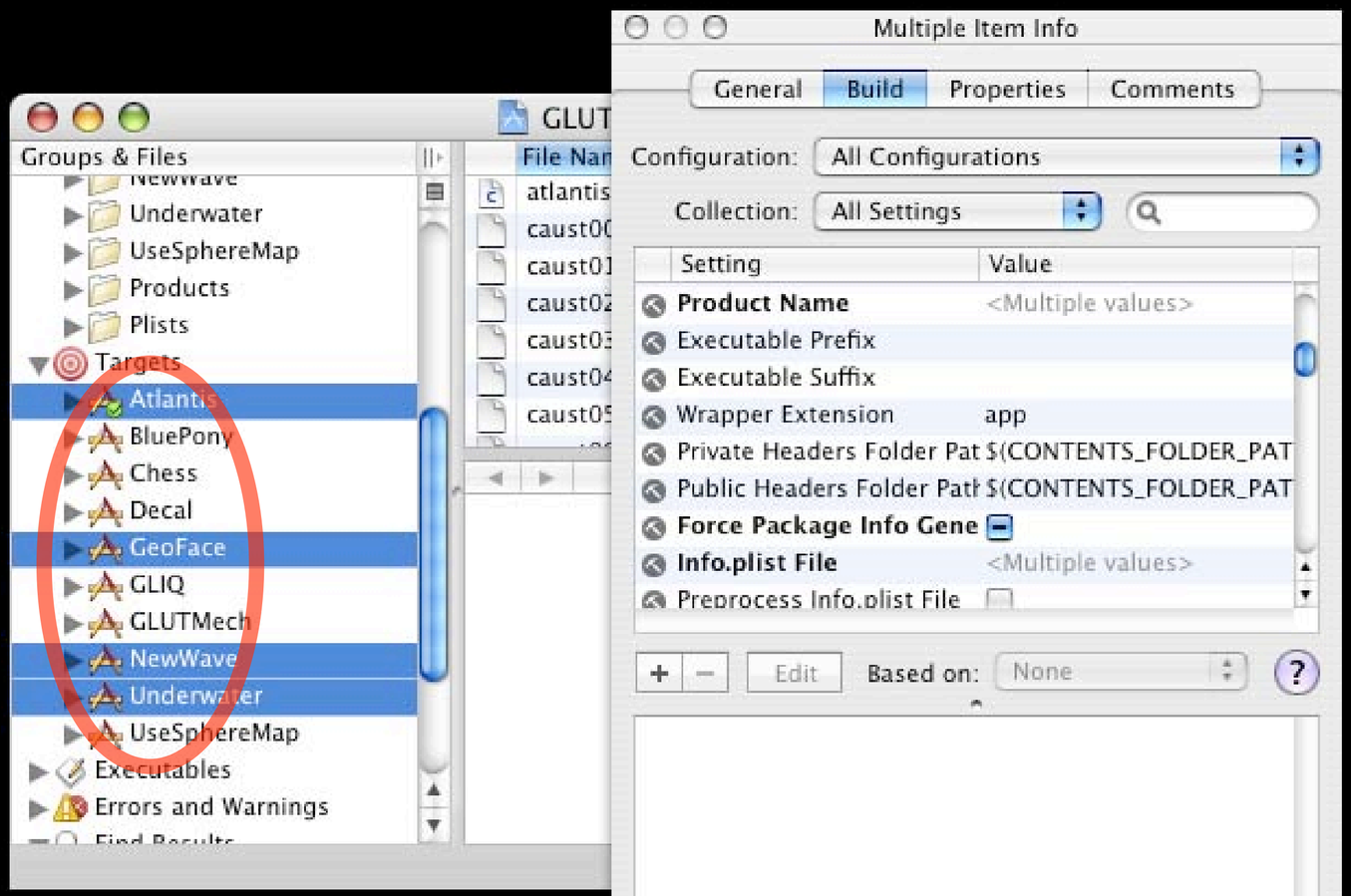

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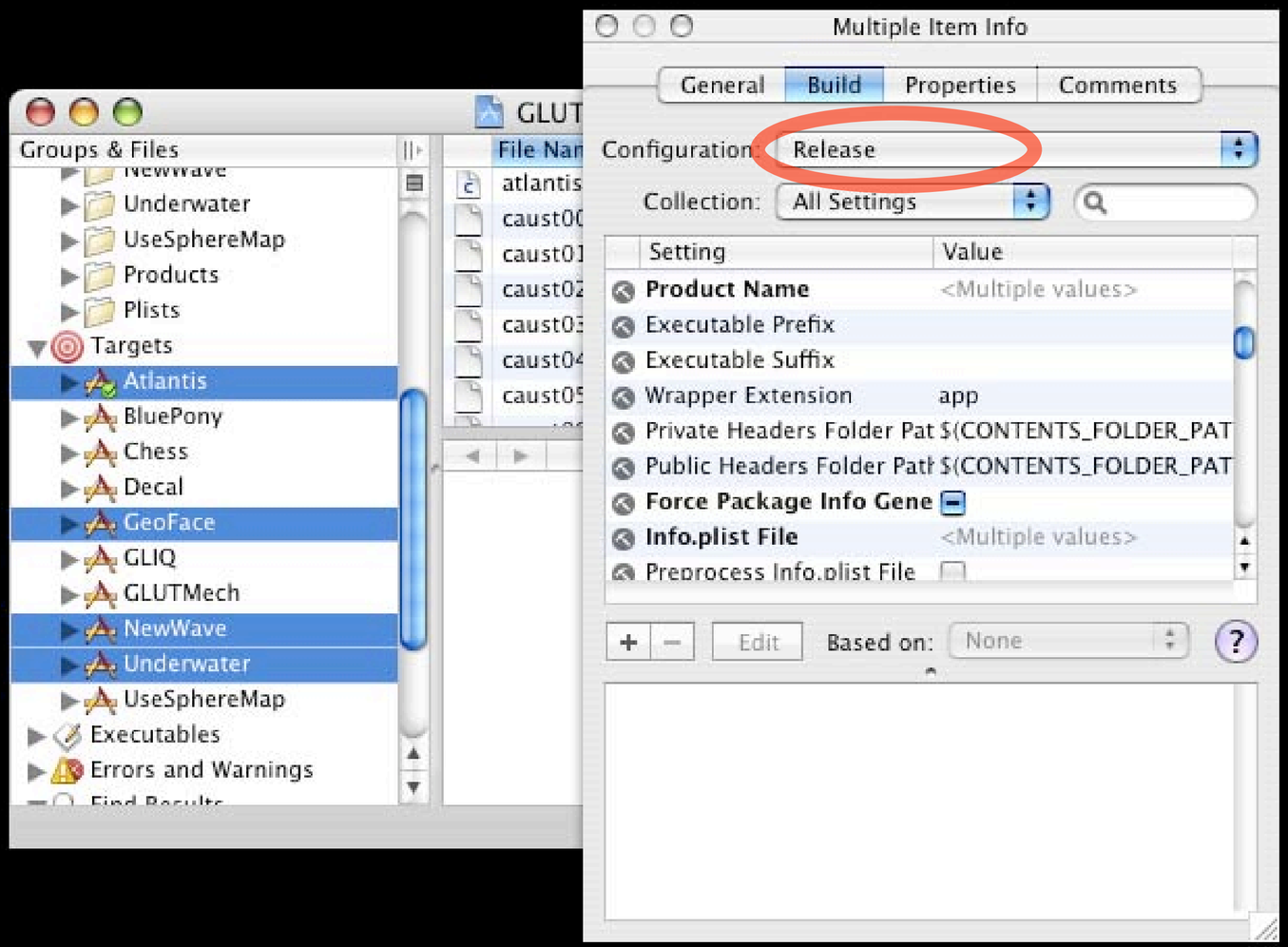

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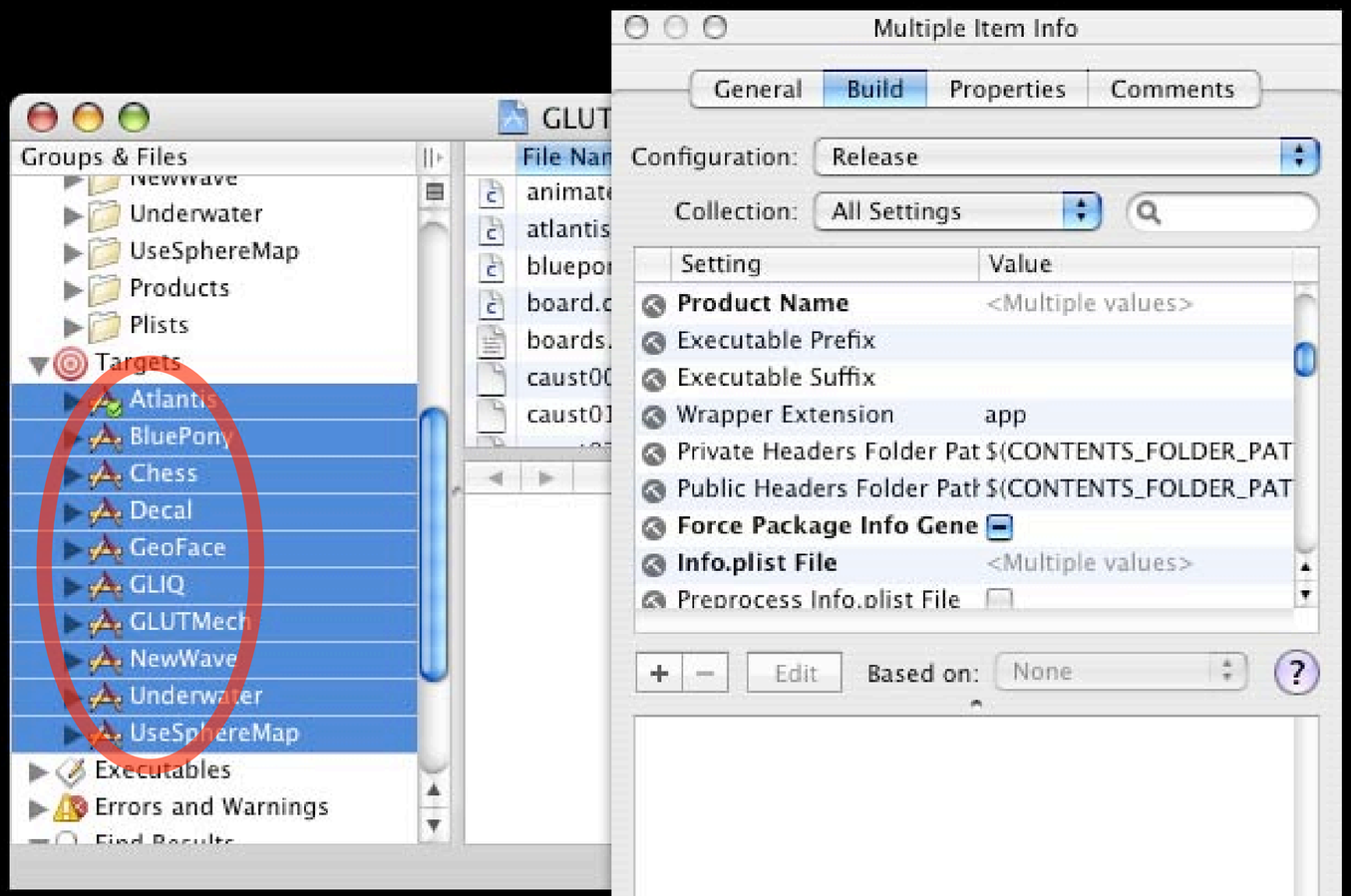

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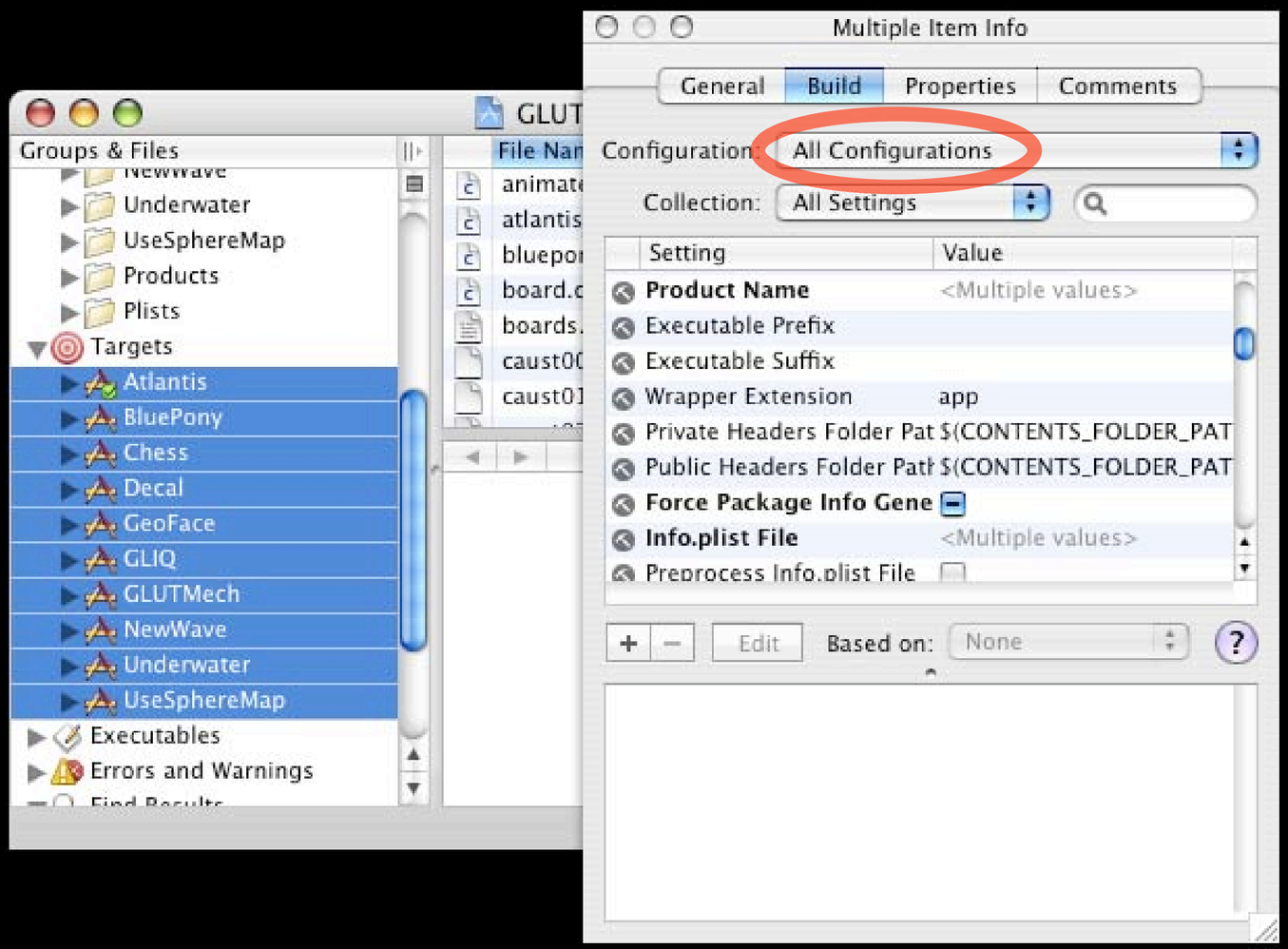

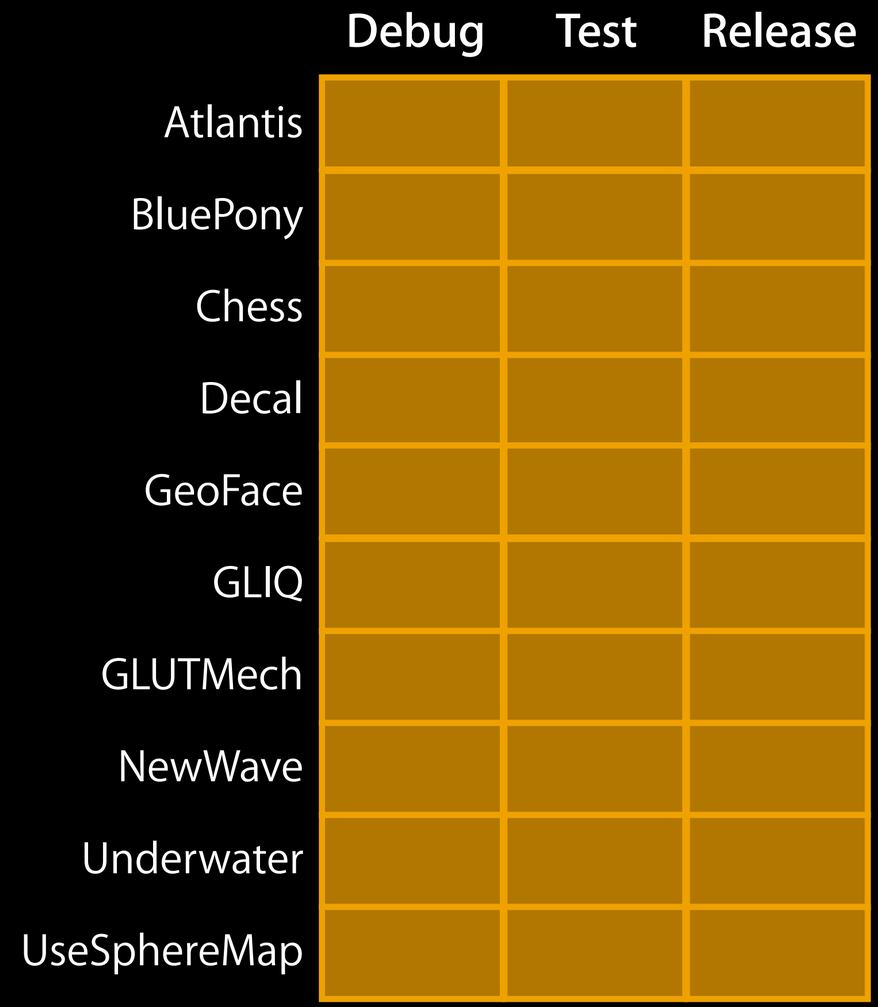

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- Targeting multiple versions of Mac OS X
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What's an SDK?

- SDK—"Software Development Kit"
- Provides build-time access to operating system functionality
- Build against a different OS release from what you're running
  - e.g. develop on Mac OS X 10.4 but allow product to run on 10.2.8
- Use of API already implies a range of Mac OS X releases
- Specifying an SDK makes that assumption explicit
  - Chosen SDK defines upper limit
  - "Mac OS X Deployment Target" setting specifies lower limit

Why Should You Use an SDK?

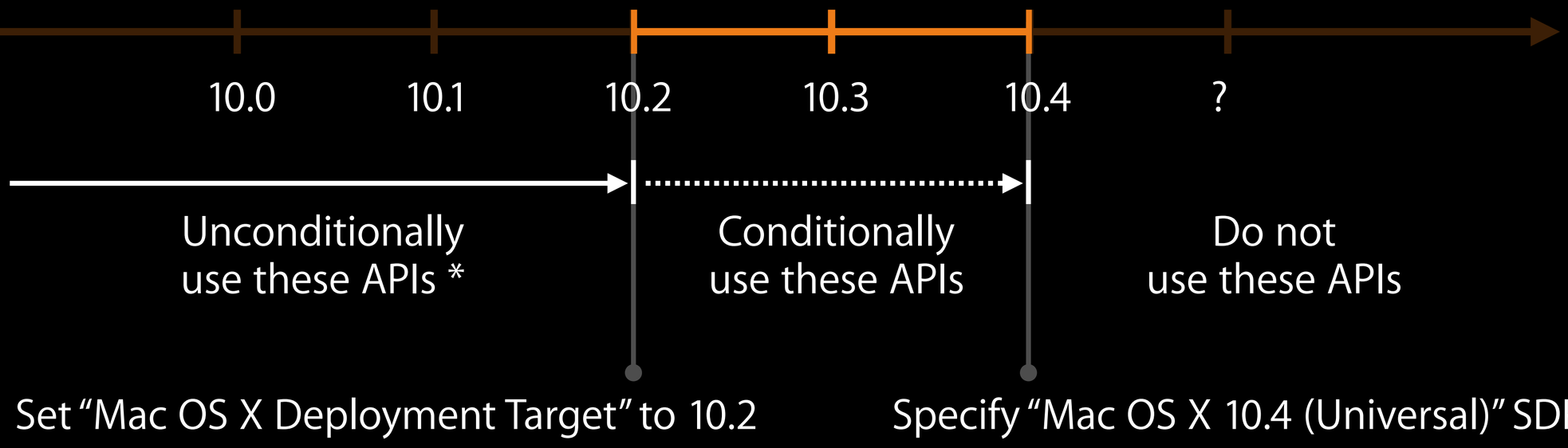
- By default, projects use the system installed on the machine
- Specifying an SDK improves consistency among machines and over time
  - SDKs don’t change over times
- SDKs also lets the build system warn about
  - Use of API that’s “too new”
  - Use of deprecated API

What's in an SDK?

- SDK are sparse directory trees mimicking the system layout
- Headers
  - Same as what shipped with the corresponding Mac OS X release
- Dynamic library stubs
  - Contain no code; only link-time information
- Static libraries
  - Contain code that's statically linked into your software product
- No compilers or other command-line tools

Using SDKs—An Example

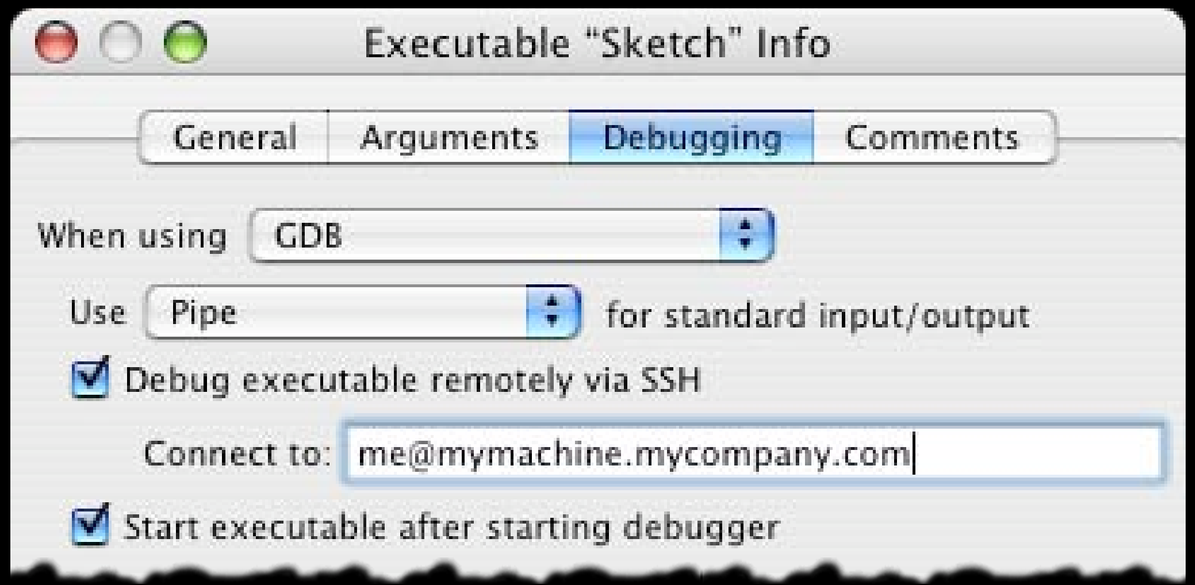
- Consider a project that wants to use 10.4 API but only require 10.2
- Specify 10.4 as the SDK, and set "Mac OS X Deployment Target" to 10.2



* avoid using existing API marked as deprecated

Debugging With SDKs

- Can debug most issues on the system you're running
- Use remote debugging to investigate issues specific to OS version
- Need developer tools installed on the remote machine



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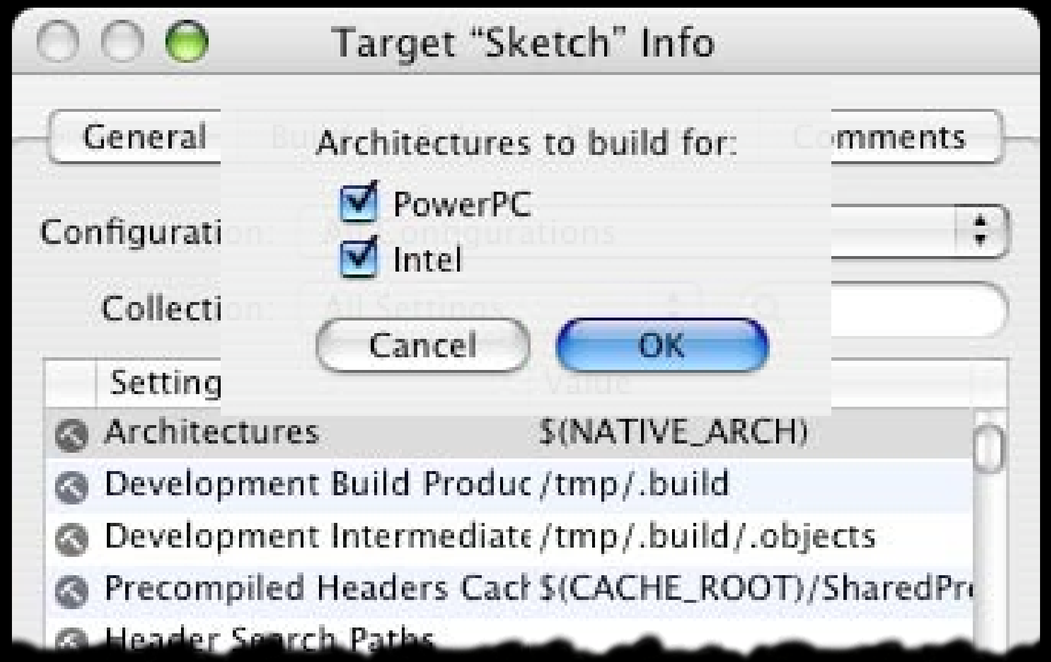
Creating Universal Binaries

- Xcode fully supports development for Intel
- Can create “universal” binaries containing both PowerPC and Intel code
- For many projects, it’s as simple as clicking a checkbox

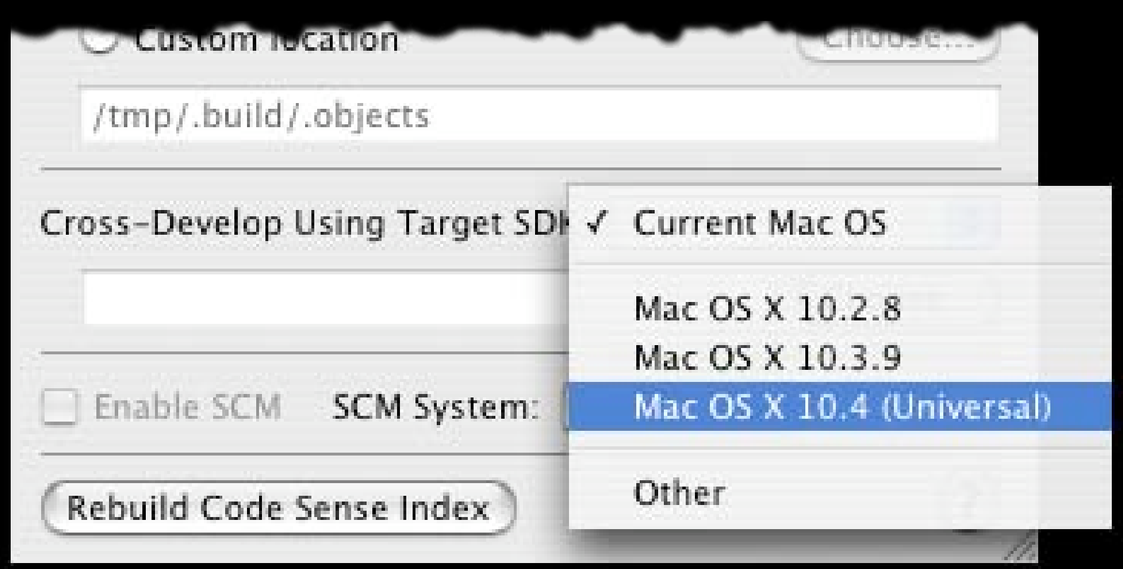


Architecture-Specific Settings

- Some build settings have architecture-specific forms
- Architecture-specific settings can be set at any level
  - Settings at target level affect only the target
  - Settings at project level affect all targets in project
  - *.xcconfig* files can be used to share common settings among projects
- Naming convention
  - Format is `<settingname>_<architecture>`
  - Architecture name is of the same form as in *arch(3)* man page
  - For historical reasons, generic Intel architecture is called “i386”
  - Example: `OTHER_CFLAGS_ppc` vs `OTHER_CFLAGS_i386`

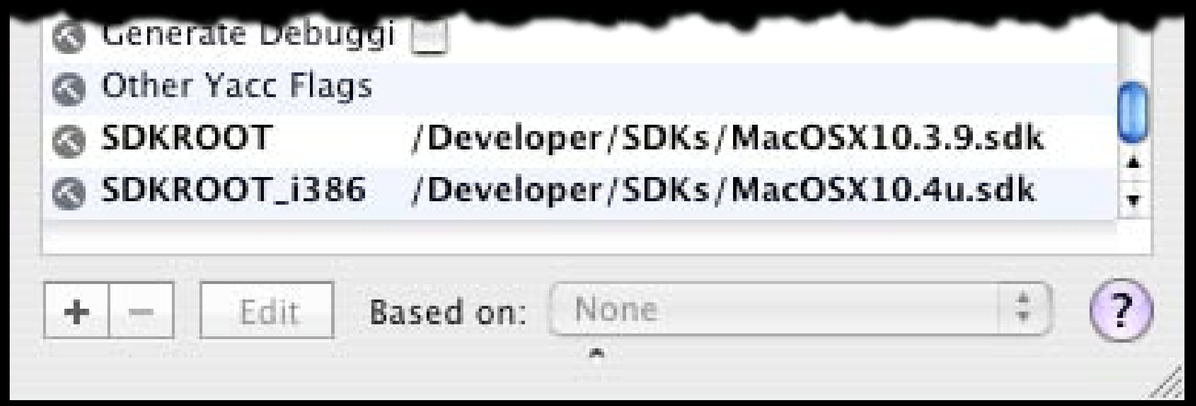
Architecture-Specific SDKs

- Xcode allows a different SDK for each architecture
- Primary SDK
  - Used for indexing and documentation lookup
  - Set in “General” tab of the project inspector, as usual



Architecture-Specific SDKs

- Xcode allows a different SDK for each architecture
- Primary SDK
  - Used for indexing and documentation lookup
  - Set in “General” tab of the project inspector, as usual
- Alternate SDKs
  - Different SDKs can be chosen for different architectures
  - Set in “Build” tab of project or target inspector, depending on desired scope



Settings Configurable Per-Architecture

- Each of these settings can be defined per-architecture
  - SDKROOT_$(arch)
  - OTHER_CFLAGS_$(arch)
  - OTHER_LDFLAGS_$(arch)
  - OTHER_LIBTOOLFLAGS_$(arch)
- If defined, SDKROOT_$(arch) overrides SDKROOT
- Settings containing flags are additive

Ordering of Architecture-Specific Flags

- Architecture-specific flags are emitted after general flags
- For example, if
  - `OTHER_CFLAGS = -Wsequence-point`
  - `OTHER_CFLAGS_i386 = -mno-fancy-math-387`
- Then the compiler command line for Intel builds is

```
... -Wsequence-point -mno-fancy-math-387 ...
```

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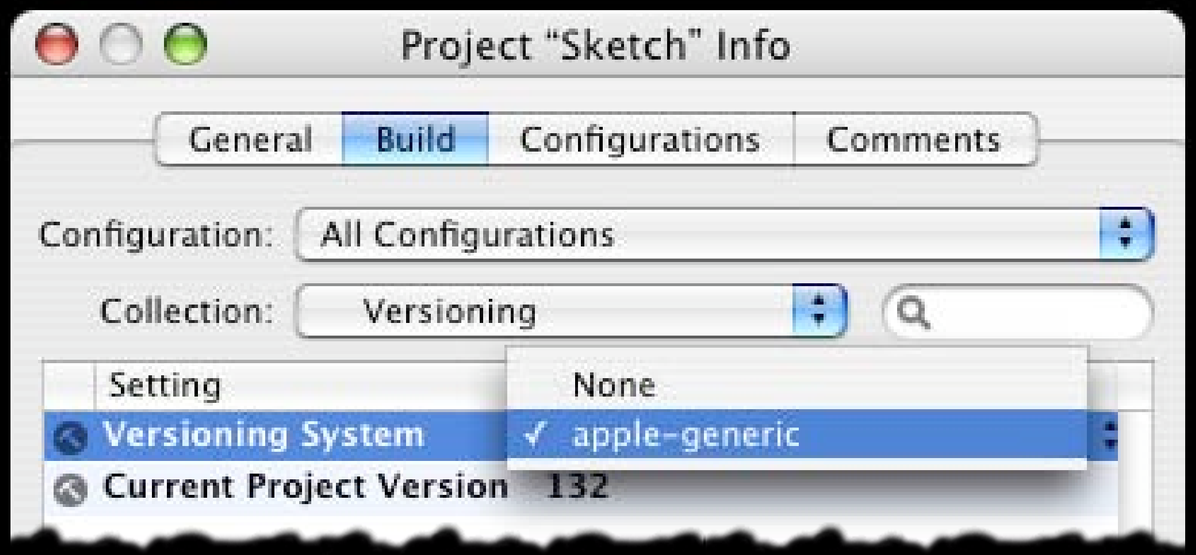
Project Versioning

- Almost all software products have a version number
- It is often useful to also have a build number
- Command line tool *agvtool* helps automate the process
- Tool supports both “marketing” and “build” version numbers

Configuring Project Versioning

- Configure your project to use “Apple Generic” versioning system
- Version number can be anything you want
  - Often useful to have it be the build number



Using agvtool

- Command line tool *agvtool* operates on build settings in project
- Handles both marketing version and build number
- Can automatically check in project changes to CVS
- Best to close project before running agvtool

```
agvtool help
agvtool what-version|vers [-terse]
agvtool next-version|bump [-all]
agvtool new-version [-all] <versNum>
agvtool tag [-force|-F] [-noupdatecheck|-Q]
agvtool what-marketing-version|mvers [-terse]
agvtool new-marketing-version <versString>
```

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Fine-Tuning Your Targets

- Precompiled prefix headers (PCHs)
- *Info.plist* processing

Precompiled Headers

- Usually, most code seen by the compiler comes from headers
- A large set of unchanging headers is often included by all source files
  - e.g. every header reachable from Carbon.h or Cocoa.h
- Example: UCarbonEvent.cpp under /Developer/Examples/
  - 54 lines of code in UCarbonEvent.cpp itself
  - 90944 total lines of code seen by the compiler after preprocessing
  - Only ~0.06% “interesting” content!
- Solution: precompile the stable headers

Setting Up Precompiled Prefix Headers

- Set at either the project or the target level
  - Create a prefix header that includes common API
  - Enable the “precompile prefix header” setting
- Xcode precompiles the prefix header on-demand
- Precompiled header is automatically shared between projects when possible
- Keep in mind
  - Prefix header gets included for all source files in target
  - Only put infrequently changed headers in the PCH

Info.plist Processing

- *Info.plist* is a property list file that tells the OS about your product
  - Identifier and icon of bundle
  - Name of Mach-O executable
  - Types and icons of documents
  - Version numbers
- Some entries are localized in an *InfoPlist.strings* file
- Some of the information is already in build settings at build time
- Xcode lets you
  - Refer to build settings from within the Info.plist file
  - Run the Info.plist file through the GCC preprocessor

Info.plist Processing

Build Setting Expansion Example

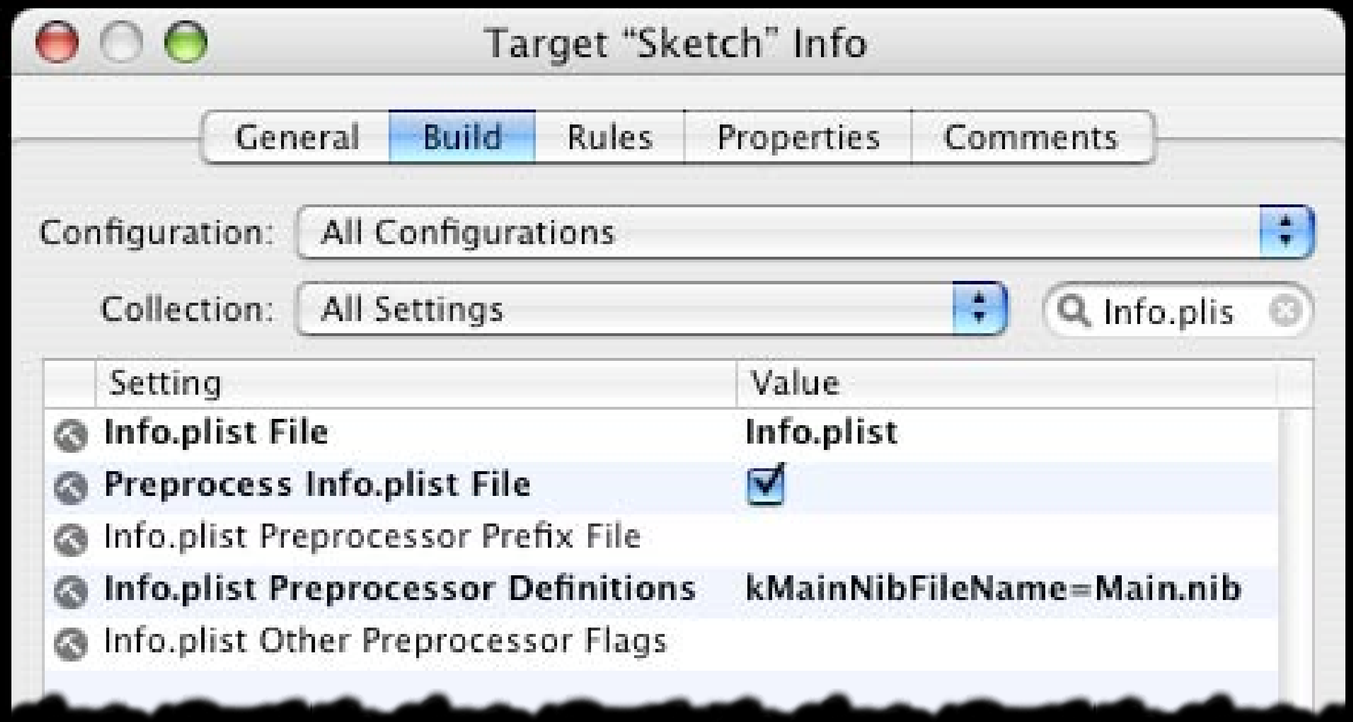
- Happens automatically—no switch needs to be enabled

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE plist PUBLIC "-//Apple Computer//DTD PLIST 1.0//EN" "http://
www.apple.com/DTDs/PropertyList-1.0.dtd">
<plist version="1.0">
<dict>
   <key>CFBundleExecutable</key>
   <string>$(EXECUTABLE_NAME)</string>
   <key>CFBundleVersion</key>
   <string>$(CURRENT_PROJECT_VERSION)</string>
   <key>CFBundleDocumentTypes</key>
   <array>
      <dict>
         <key>CFBundleTypeExtensions</key>
```

Info.plist Processing

GCC Preprocessing Example

- Enabled using the project or target inspector
- Can also define Info.plist-specific preprocessor macros here



Info.plist Processing

GCC Preprocessing Example

- Use preprocessor directives and preprocessor macro names in Info.plist

```
#include "CommonInfoPlistSettings.h"
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE plist PUBLIC "-//Apple Computer//DTD PLIST 1.0//EN" "http://
www.apple.com/DTDs/PropertyList-1.0.dtd">
<plist version="1.0">
<dict>
   <key>kMainNibFileName</key>
   <string>Draw2</string>
#ifdef ENABLE_SCRIPABILITY
   <key>NSAppleScriptEnabled</key>
   <string>YES</string>
#endif
   <key>NSPrincipalClass</key>
```

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Demo

Project Configuration

http://developer.apple.com/wwdc2005/

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More Information

http://developer.apple.com/wwdc2005/

Documentation, Sample Code, and Other Resources

http://developer.apple.com/wwdc2005/

Related Sessions

Development Tools Feedback Forum	Session 410 Friday 5:00PM

Who to Contact

Matthew Formica
Developer Tools and Cocoa Evangelist
mformica@apple.com

xcode-users Discussion List
Community-Based Support for Xcode Users
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Q&A

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